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Aquatic Toxicity Screening of Fire Fighting Agents; 2003 Report

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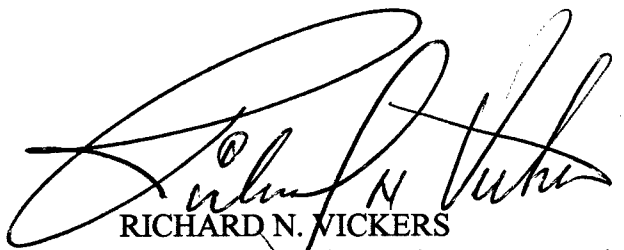
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14. ABSTRACT This series of laboratory experiments was initiated to determine the expected median lethal concentration (LC50) of various fire fighting foams using the Fathead Minnow (<i>Pimephales promelas</i>) as the screening organism. Aquatic toxicity screening offers an inexpensive, efficient and reliable method for determining the toxic effects of a substance on a given organism. Toxicity screens were conducted for nine agents between 1 Jun and 18 Dec 2003, in which the minnows were exposed to five concentration of the fire fighting agent while a simultaneous test was performed with five concentrations of 3M Light Water Brand Aqueous Film Forming Foam (AFFF), the reference toxicant. The aquatic toxicity screening consisted of an acute, static, range-finding test conducted over a 48-hour period. Dissolved oxygen, pH and temperature were monitored throughout the experiment. The agents screened included 6 commercial agents (FlameOut II, FireAde 2000, Hawk ALLFIRE, EarthSorb, Hawk Super B and Micro-Blaze Out Plus) and three experimental agents (PS B-25, TDA 555-8 and TDA 541-3). The calculated LC50s for the nine agents screened ranged between 9.5 and 1595 ppm. 3M AFFF had an average LC50 of 784 ppm. All agents screened, with the exception of Micro-Blaze Out Plus and EarthSorb, had a LC50 lower than 3M AFFF.						
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ABSTRACT

This series of laboratory experiments was initiated to determine the expected median lethal concentration (LC50) of various fire fighting foams using the Fathead Minnow (*Pimephales promelas*) as the screening organism. Aquatic toxicity screening offers an inexpensive, efficient and reliable method for determining the toxic effects of a substance on a given organism. Toxicity screens were conducted for nine agents between June 1 and December 18, 2003, in which the minnows were exposed to five concentrations of the fire fighting agent while a simultaneous test was performed with five concentrations of 3M Light Water Brand Aqueous Film Forming Foam (AFFF), the reference toxicant. The aquatic toxicity screening consisted of an acute, static, range-finding test conducted over a 48-hour period. Dissolved oxygen, pH and temperature were monitored throughout the experiment.

The agents screened included six commercial agents (FlameOut II, FireAde 2000, Hawk ALLFIRE, EarthSorb, Hawk Super B and Micro-Blaze Out Plus) and three experimental agents (PS B-25, TDA 555-8 and TDA 541-3). The calculated LC50s for the nine agents screened ranged between 9.5 and 1595 ppm. 3M AFFF had an average LC50 of 784 ppm. All agents screened, with the exception of Micro-Blaze Out Plus and EarthSorb, had a LC50 lower than 3M AFFF.

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SUMMARY

Due to overwhelming requests submitted to the DoD and FAA, AFRL issued an invitation to screen various fire fighting agent formulations submitted by outside companies in an effort to evaluate the toxicity of commercial and experimental foam concentrates against current Military Specification MIL-F-24385F Fire Extinguishing Agent, Aqueous Film Forming Foam Liquid Concentrate, For Fresh and Sea Water (MIL SPEC AFFF).

This series was conducted under a joint program with the Federal Aviation Administration as a means to centralize the screening and information made available on commercial and experimental fire fighting agents. Agents that were considered for further evaluation must show a decreased level of toxicity compared to the MIL SPEC AFFF, which has a known aquatic toxicity between 700-950 ppm.

METHODS

Toxicity screening on nine fire fighting agents was conducted at the Air Force Research Laboratory (AFRL/MLQD) to determine the expected median lethal concentration (LC50) using the Fathead Minnow (*Pimephales promelas*) as the test organism. The agents tested included six commercial agents (Flame Out II, FireAde 2000, Hawk ALLFIRE, EarthSorb, Hawk Super B and Micro-Blaze Out Plus) and three experimental agents (PS B-25, TDA 555-8 and TDA 541-3). Toxicity screening and analysis of the nine agents were conducted between June 2003 and December 2003 at AFRL, Fire Research Chemical Analysis Center at Tyndall AFB, Florida.

The Fathead minnows were subjected to a 48-hour, acute, static, range-finding aquatic toxicity test (ASTM E729-96). Five concentrations of each test agent and 3M Light Water Brand AFFF were tested with a total of 40 organisms exposed to each toxicant concentration. During the 48-hour experiment, dissolved oxygen concentration, pH and temperature were monitored to assure optimal water quality conditions. LC50 (median lethal concentration) results were generated using Tidepool Scientific ToxCalc™ Bioassay Calculator software. The LC50 data were calculated using the Trimmed Spearman-Kärber Method and the results are given in parts per million (ppm).

RESULTS

The first sample of FireAde 2000 had a pH of 12.4, which resulted in the fish dissolving once they died. The pH was verified with Fire Service Plus and found to be above the normal neutral pH. A second sample of normal pH (7.2) was received and screened. Results from both tests are reported in this document.

Seven out of the nine agents tested were more toxic than AFFF. Micro-Blaze Out Plus, a fluorosurfactant based foam similar to 3M Light Water Brand AFFF, had a LC50 equal to MIL SPEC AFFF. EarthSorb, a pinto bean based agent, was less toxic than AFFF but

significantly decreased the oxygen levels due to the nutrient loading. The toxicity of the other agents ranged from 9.5 ppm to 133 ppm. Hawk Super B was the most toxic agent in this series at 83 times more toxic than AFFF.

All three experimental agents showed high degrees of toxicity, ranging from 26-133 ppm.

SECTION I: INTRODUCTION

BACKGROUND

Fire fighting foams are used as the primary suppression agent to extinguish liquid hydrocarbon fuel fires involving aircraft operations. Several types of foam exist including protein, fluoroprotein and aqueous film-forming foams (AFFF). Currently, AFFF is the most effective fire fighting foam available and is the primary agent for hydrocarbon fuel fires. The general composition of AFFF is water, fluoroalkyl surfactants, non-fluorinated surfactants and organic solvent.

Due to overwhelming requests submitted to the DoD and FAA, AFRL issued an invitation to test various foam formulations submitted by outside companies in an effort to evaluate the toxicity of commercial and experimental foam concentrates against current MIL SPEC AFFF.

This test series was conducted under a joint program with the Federal Aviation Administration as a means to centralize the screening and information made available on commercial and experimental fire fighting agents. This report summarizes the aquatic toxicity screening conducted during the 2003 calendar year.

PURPOSE

The purpose of this screening is to quantify the aquatic toxicity of new fire fighting foams using an inexpensive, efficient, reliable method for comparison to current MIL SPEC AFFF.

SCOPE

A series of screenings were conducted to determine the median lethal concentration (LC50) of nine fire fighting foam concentrates using ASTM E-729 – 96 (Reapproved 2002) Standard Guide for Conducting Acute Toxicity Tests on Test Materials with Fishes, Macroinvertebrates and Amphibians using the Fathead Minnow (*Pimephales promelas*) as the test organism. The tests and subsequent analysis were conducted at the Air Force Research Laboratory (AFRL), Fire Research Group, Tyndall AFB, Florida.

SECTION II: METHODS

PROCEDURE

Nine independent toxicity tests were completed between June 1, 2003 and December 18, 2003 using the Fathead Minnow as the test organism. The ASTM E 729-96 Standard specifies that all organisms in a test should be as uniform as possible in age and size. To provide a consistent age class, Aquatic Research Organisms, Hampton, New Hampshire at the beginning of each trial, provided 19-day-old laboratory-reared fish. Dissolved oxygen levels were maintained between 60 and 100% of saturation and the fish did not incur a temperature fluctuation of more than 3°C in any 12-hour period. The minnows were subjected to a 48-hour, acute, static, range-finding toxicity test. A range-finding test, according to the United States Environmental Protection Agency (USEPA), consists of scaled-down, abbreviated static acute test in which groups of organisms are exposed to several widely-spaced sample dilutions in a logarithmic series. Forty fish (twenty each, in duplicate chambers) were exposed to varying concentrations of foam.

Upon arrival, the shipping water was analyzed for dissolved oxygen (DO) concentration, pH and temperature to assure that no extreme changes in the water quality occurred during transport (Appendix A). The test water was also analyzed for DO, pH and temperature. A water filtration system installed by USFilter was used as the source of purified water, which was oxygenated for 48 hours prior to the test.

Five concentrations of the test agents were used during the trials, ranging from 60,000-0.6 ppm or 30,000-0.3 ppm, depending on the manufacturer's recommendation for normal proportioning. Each concentration was one order of magnitude lower than the previous, starting with the recommended use concentration. Five concentrations (30,000-0.3 ppm) of 3M Light Water Brand AFFF were run simultaneously as a control and reference toxicant with each trial of an agent. Two chambers of fish with no agent added were used as a blank control. Each test chamber contained one liter of water and 20 fish, with each concentration having a duplicate test chamber. Therefore, forty fish were exposed to each concentration. Measurements, including pH, DO concentrations and temperature were taken at times 0, 4, 24 and 48-hours and recorded on data sheets (Appendix B). The fish were not fed 24-hours prior to or during the experiment.

ANALYSIS

LC50 results were generated using the Tidepool Scientific ToxCalc™ Bioassay Calculator software. The data were calculated using the Trimmed Spearman-Kärber Method and the results were shown in parts per million (ppm). Typical program output is shown in Appendix C.

SECTION III: RESULTS

Table 1 summarizes the test results. Commercial agents are shown in red, experimental agents are shown in blue.

Table 1. Summary of Aquatic Toxicity Results for the Nine Agents Tested.

LC50 RESULTS (ppm)			
DATE	AGENT NAME	AGENT (ppm)	AFFF (ppm)
6/20/03	FlameOut II	66	705
6/20/03	FireAde 2000*	74	705
6/27/03	PS B-25	109	718
7/18/03	TDA 555-8	26	718
7/18/03	TDA 541-3	133	718
8/1/03	FireAde 2000**	92	768
8/8/03	Hawk ALLFIRE	57	780
12/19/03	EarthSorb	1595	949
12/12/03	Hawk Super B	9.5	949
12/12/03	Micro BlazeOut +	949	949

*FireAde 2000 with pH=12.4

**FireAde 2000 with pH=7.2

For nine of the ten trials, dissolved oxygen concentrations, pH and temperature remained within expected limits (Appendix B). Aquatic toxicity was listed in ppm, with lower numbers indicating more toxic agent. Hawk Super B exhibited the highest toxicity at 9.5 ppm, while EarthSorb and Micro BlazeOut Plus exhibited the lowest toxicity at 1595 and 949 ppm, respectively. The remaining commercial agents ranged between 57-133 ppm, which is over 10 times the level of toxicity of MIL SPEC AFFF.

The first toxicity screen performed with FireAde 2000 had an unusual reaction with the fish. After the fish died, the remains turned to a gel-like consistency. This result had never been observed with any other agent. Additional analysis of the foam concentrate showed that the pH (12.4) was higher than the neutral pH indicated by the manufacturer. The manufacturer sent a second sample for testing and the first batch of foam was sent back to the manufacturer for analysis. The second batch of FireAde 2000 was closer to neutral; however, this did not significantly improve the LC50 (74 to 92 ppm), indicating that the high level of toxicity was not due to pH alone.

PS B-25 was not completely soluble in water, even though the MSDS provided by the manufacturer indicated that it was completely soluble. Some portion of the two highest concentrations remained out of solution at the bottom of the test chamber. The lack of thorough mixing was not an issue since both concentrations experienced 100% mortality within the first four hours of the screen. The three lowest concentrations were completely soluble. The remaining two experimental agents also showed higher toxicity levels than AFFF.

The EarthSorb agent demonstrated had the highest LC50 at 1595 ppm, indicating that the agent is less toxic than AFFF. However, the EarthSorb agent decreased the dissolved oxygen content to < 0.1 mg/L in the top two concentrations. Fathead minnows normally congregate at the bottom of the test chamber. However, with the dissolved oxygen level almost at zero, the fish were swimming at the top of the agent/water surface where dissolved oxygen levels were the highest. This significant decrease in DO was probably due to the excess nitrogen released into the water from the pinto beans. Nitrogen loading in freshwater causes eutrophication of the system when an excess of bacteria deplete the oxygen in the water. This could be a significant problem if this agent were released into a water body.

Micro-Blaze Out Plus performed equivalent to the AFFF control. The ingredients listing in the material safety data sheets for Micro-Blaze Out Plus and AFFF are similar. Micro-Blaze Out Plus is essentially an AFFF with microbes added to degrade the hydrosurfactants after use.

In a study performed by Pace Analytical Laboratories, St. Paul, Minnesota for 3M (Lab Request #G1358) on Light Water Brand AFFF, a LC50 of >1000 ppm was calculated at 48 hours for the Fathead Minnow during a 96 hour static toxicity test. These results correlate with the AFFF results produced during the ten trials completed between June 2003 and December 2003.

APPENDIX A: DATA SHEETS – INITIAL INFORMATION

AQUATIC TOXICITY TEST – FLAMEOUT II

DATE: 18 June 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: FlameOut II

TEST AGENT CONC: 3.0%, 0.30%, $3.0 \times 10^{-2}\%$, $3.0 \times 10^{-3}\%$, $3.0 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 28 May 2003

TEMPERATURE OF SHIPPING WATER: 22°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – FIREADE 2000

DATE: 20 June 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: Fire Ade 2000

TEST AGENT CONC: 3.0%, 0.3%, $3.0 \times 10^{-2}\%$, $3.0 \times 10^{-3}\%$, $3.0 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 28 May 2003

TEMPERATURE OF SHIPPING WATER: 22°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – PS B-25

DATE: 27 June 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: PS B-25

TEST AGENT CONC: 6.0%, 0.6%, $6.0 \times 10^{-2}\%$, $6.0 \times 10^{-3}\%$, $6.0 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 4 June 2003

TEMPERATURE OF SHIPPING WATER: 23°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – TDA 555-8

DATE: 18 July 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: TDA 555-8

TEST AGENT CONC: 6.0%, 0.6%, $6.0 \times 10^{-2}\%$, $6.0 \times 10^{-3}\%$, $6.0 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 25 June 2003

TEMPERATURE OF SHIPPING WATER: 24°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – TDA 541-3

DATE: 18 July 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: TDA 541-3

TEST AGENT CONC: 1.5%, 0.15%, $1.5 \times 10^{-2}\%$, $1.5 \times 10^{-3}\%$, $1.5 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 25 June 2003

TEMPERATURE OF SHIPPING WATER: 24°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – FIREADE 2000

DATE: 1 August 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: FireAde 2000

TEST AGENT CONC: 3.0%, 0.3%, $3.0 \times 10^{-2}\%$, $3.0 \times 10^{-3}\%$, $3.0 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 9 July 2003

TEMPERATURE OF SHIPPING WATER: 22°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – HAWK ALLFIRE

DATE: 8 August 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: Hawk ALLFIRE

TEST AGENT CONC: 3.0%, 0.30%, $3.0 \times 10^{-2}\%$, $3.0 \times 10^{-3}\%$, $3.0 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 17 July 2003

TEMPERATURE OF SHIPPING WATER: 24°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – EARTHSORB

DATE: 9 December 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: EarthSorb

TEST AGENT CONC: 5g/L, 0.5g/L, 5.0×10^{-2} g/L, 5.0×10^{-3} g/L, 5.0×10^{-4} g/L

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 27 November 2003

TEMPERATURE OF SHIPPING WATER: 24°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – HAWK SUPER B

DATE: 9 December 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: Hawk Super B

TEST AGENT CONC: 3.0%, 0.30%, $3.0 \times 10^{-2}\%$, $3.0 \times 10^{-3}\%$, $3.0 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 19 November 2003

TEMPERATURE OF SHIPPING WATER: 22°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

AQUATIC TOXICITY TEST – MICRO BLAZEOUT +

DATE: 9 December 03

TEST TYPE: Acute, static, range-finding

TEST AGENT: Micro BlazeOut +

TEST AGENT CONC: 3.0%, 0.30%, $3.0 \times 10^{-2}\%$, $3.0 \times 10^{-3}\%$, $3.0 \times 10^{-4}\%$

TEST SPECIES: *Pimephales promelas*, Fathead Minnow

SPECIES SOURCE: Aquatic Research Organisms

DATE HATCHED: 19 November 2003

TEMPERATURE OF SHIPPING WATER: 22°C

TEMPERATURE OF CHAMBER WATER: 22°C

DILUTION H₂O: Deionized Water, aerated 48 hours

**APPENDIX B: DATA SHEETS – EXPERIMENTAL
MEASUREMENTS**

TEST AGENT: FireAde 2000, 20 June 2003

	t = 0				t = 4				t = 24				t = 48			
	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp
Control 1	0/20	7.1	7.36	21.8	0/20	7.14	7.24	21.8	0/20	7.2	6.8	22.1	2/20	7.18	6.74	21.9
Control 2	0/20	7.22	7.38	21.7	0/20	7.11	7.3	21.8	1/20	6.94	6.83	22	1/20	6.98	6.87	21.8
Test Agent																
3 ppm	0/20	7.47	7.54	22	0/20	7.02	7.02	21.8	0/20	6.84	6.78	22	2/20	6.94	6.74	21.8
Duplicate	0/20	7.24	7.47	21.8	1/20	6.94	7.1	21.8	1/20	6.81	6.73	21.9	1/20	6.88	6.76	21.7
30 ppm	0/20	7.42	7.55	21.8	0/20	7.19	7.18	21.8	2/20	6.82	6.61	21.9	6/20	6.82	6.4	21.7
Duplicate	0/20	7.52	7.42	21.8	0/20	7.22	7.19	21.7	0/20	6.84	6.48	21.9	1/20	6.86	6.45	21.7
300 ppm	20/20	9.69	7.65	21.9												
Duplicate	20/20	9.92	7.75	21.8												
3,000 ppm	20/20	11.13	7.87	21.8												
Duplicate	20/20	11.08	7.78	21.8												
30,000 ppm	20/20	12.14	7.87	21.9												
Duplicate	20/20	12.12	7.73	21.8												
AFFF																
3 ppm	0/20	7.51	7.59	21.9	0/20	7.26	7.27	22	1/20	7.22	7.07	22	3/20	7.1	6.87	21.8
Duplicate	0/20	7.25	7.68	21.9	0/20	7.25	7.17	22.1	0/20	7.01	6.89	22.1	4/20	6.97	6.57	21.9
30 ppm	0/20	7.15	7.52	21.9	0/20	7.03	7.21	21.9	1/20	6.98	6.87	22	3/20	6.89	6.48	21.8
Duplicate	0/20	7.25	7.64	21.9	0/20	7.13	7.21	22	0/20	7.04	6.81	22.1	4/20	6.94	6.22	21.8
300 ppm	0/20	7.23	7.54	21.9	0/20	7.1	7.29	21.9	0/20	7.04	6.83	22	1/20	6.72	5.64	21.8
Duplicate	0/20	7.27	7.56	21.8	4/20	7.24	7.27	21.9	6/20	7.05	6.66	22	8/20	6.81	5.72	21.8
3,000 ppm	0/20	7.34	7.58	21.9	0/20	7.26	7.27	21.9	17/20	7.12	6.44	22	20/20	6.59	0.24	21.9
Duplicate	0/20	7.31	7.56	21.8	0/20	7.22	7.3	22	12/20	7.07	6.43	22.1	20/20	6.51	0.17	21.9
30,000 ppm	20/20	7.62	7.86	21.9												
Duplicate	20/20	7.59	7.84	21.8												

TEST AGENT: PS B-25,
27 June 2003

	t = 0				t = 4				t = 24				t = 48			
	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp
Control 1	0/20	7.18	7.46	22.6	0/20	7.04	7	23.9	0/20	7.15	6.55	22.1	1/20	6.93	6.34	23
Control 2	0/20	7.1	7.41	22.6	0/20	7	6.95	23.8	0/20	7.01	6.52	21.9	0/20	6.92	6.34	23.1
Test Agent																
6 ppm	0/20	7.27	7.42	23.1	0/20	7.2	6.93	23.7	1/20	6.97	6.34	22	2/20	6.8	5.87	23.1
Duplicate	0/20	7.19	7.42	23.2	0/20	7.11	6.96	23.8	0/20	6.96	6.47	22	2/20	6.79	6.02	23.2
60 ppm	0/20	7.1	7.39	22.7	0/20	6.99	6.88	23.5	4/20	6.9	6.15	21.9	4/20	6.72	5.8	23.1
Duplicate	0/20	7.08	7.4	22.7	0/20	6.93	6.94	23.6	5/20	6.87	6.28	21.9	7/20	6.74	5.88	23.1
600 ppm	0/20	7.02	7.4	22.6	7/20	6.81	6.88	23.6	19/20	6.8	5.29	21.9	19/20	6.67	2.84	23
Duplicate	1/20	6.27	7.44	22.6	20/20	6.37	7.13	23.6	20/20	6.52	4.51	21.9				
6,000 ppm	4/20	5.91	7.33	22.7	20/20	5.87	7.2	23.6								
Duplicate	3/20	6.09	7.29	22.7	20/20	6.07	7.19	23.6								
60,000 ppm	20/20	5.94	7.4	22.9												
Duplicate	20/20	6.01	7.38	22.9												
AFFF																
3 ppm	0/20	7.18	7.28	22.6	0/20	7.04	7	23.8	0/20	6.97	6.6	22	2/20	6.91	6.42	23.1
Duplicate	0/20	7.08	7.55	22.5	0/20	6.95	6.96	23.6	0/20	6.89	6.59	22	1/20	6.86	6.41	23
30 ppm	0/20	7.05	7.42	22.6	0/20	6.94	6.91	23.5	0/20	6.78	5.91	21.9	0/20	6.73	5.84	22.9
Duplicate	0/20	7.09	7.36	22.5	0/20	6.98	7.01	23.5	0/20	6.72	6.01	21.9	1/20	6.65	5.88	22.9
300 ppm	0/20	7.04	7.37	22.5	1/20	6.92	6.87	23.4	1/20	6.65	5.03	21.8	3/20	6.33	2.86	22.9
Duplicate	0/20	7.08	7.45	22.4	0/20	7	6.9	23.5	0/20	6.69	5.31	21.9	3/20	6.3	3.11	22.9
3,000 ppm	0/20	7.26	7.24	22.4	0/20	7.2	6.94	23.5	6/20	6.81	3.88	21.9	20/20	6.49	0.3	22.9
Duplicate	0/20	7.24	7.31	22.4	0/20	7.19	6.97	23.5	0/20	6.81	4.64	21.8	20/20	6.46	0.25	22.9
30,000 ppm	20/20	7.54	7.31	22.4												
Duplicate	20/20	7.53	7.28	22.4												

TEST AGENT: TDA 555-8,
18 July 2003

	t = 0					t = 4					t = 24					t = 48				
	Mortality	pH	DO	Temp		Mortality	pH	DO	Temp		Mortality	pH	DO	Temp		Mortality	pH	DO	Temp	
Control 1	0/20	7.38	7.45	22		0/20	6.98	6.84	23.9		1/20	6.79	6.23	22.2		2/20	6.89	5.98	21.7	
Control 2	0/20	7.39	7.49	22		0/20	6.9	6.93	23.8		0/20	6.68	6.38	22.2		0/20	6.85	6.05	21.7	
Test Agent																				
6 ppm	0/20	7.53	7.46	21.8		0/20	7.24	6.9	23.7		0/20	7.09	6.36	22.2		0/20	7.11	6.16	21.7	
Duplicate	0/20	7.45	7.44	21.8		0/20	7.22	6.88	23.6		0/20	7.08	6.39	22.2		0/20	7.11	6.17	21.7	
60 ppm	0/20	7.36	7.37	21.7		1/19	7.16	6.92	23.6		12/20	6.97	5.48	22.1		15/20	7.02	5.12	21.6	
Duplicate	0/20	7.59	7.58	21.8		19/20	7.38	7.18	23.5		20/20	7.07	5.49	22.1						
600 ppm	20/20	7.34	7.54	21.7																
Duplicate	20/20	7.29	7.56	21.7																
6,000 ppm	20/20	6.56	7.47	21.8																
Duplicate	20/20	6.59	7.54	21.8																
60,000 ppm	20/20	6.2	7.57	21.8																
Duplicate	20/20	6.15	7.51	21.8																
AFFF																				
3 ppm	0/20	6.98	7.2	22.2		1/20	6.96	6.63	24		1/20	6.94	6.09	22.2		2/20	7.01	5.86	21.6	
Duplicate	0/20	6.98	7.24	22.1		0/20	6.94	6.67	24		0/20	6.96	6.3	22.1		0/20	7	6.26	21.6	
30 ppm	2/20	6.97	7.24	22		4/20	6.92	6.5	23.8		4/20	6.74	5.66	22		4/20	6.77	4.94	21.6	
Duplicate	0/20	7	7.35	21.9		0/20	6.93	6.84	23.8		0/20	6.72	6.05	22		3/20	6.78	4.97	21.5	
300 ppm	0/20	7.26	7.5	21.9		3/20	6.98	6.93	23.7		3/20	6.38	4.51	21.9		20/20	5.33	2.8	21.5	
Duplicate	0/20	7.06	7.49	21.9		1/20	6.82	6.93	23.8		1/20	6.25	4.76	22		13/20	4.87	3.54	21.6	
3,000 ppm	1/20	7.21	7.44	21.9		2/20	7.08	6.89	23.7		7/20	6.53	3.37	21.9		20/20	5.97	0.29	21.5	
Duplicate	1/20	7.11	7.36	21.9		1/20	7.02	6.79	23.8		1/20	6.45	2.56	21.9		20/20	6.04	0.24	21.6	
30,000 ppm	20/20	7.51	7.4	22																
Duplicate	20/20	7.46	7.39	22.1																

TEST AGENT:

TDA 541-3,
18 July 2003

	t = 0				t = 4				t = 24				t = 48			
	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp
Control 1	0/20	7.38	7.45	22	0/20	6.98	6.84	23.9	1/20	6.79	6.23	22.2	2/20	6.89	5.98	21.7
Control 2	0/20	7.39	7.49	22	0/20	6.9	6.93	23.8	0/20	6.68	6.38	22.2	0/20	6.85	6.05	21.7
Test Agent																
1.5 ppm	0/20	7.20	7.38	21.7	0/20	6.87	6.63	23.7	0/20	6.83	6.06	22.1	4/20	6.88	5.72	21.6
Duplicate	0/20	7.40	7.49	21.7	0/20	7.04	6.85	23.7	1/20	6.93	6.01	22.2	2/20	6.94	5.64	21.7
15 ppm	0/20	7.33	7.5	21.6	0/20	7.02	6.96	23.5	0/20	6.9	6.3	22.1	1/20	6.91	5.77	21.5
Duplicate	0/20	7.28	7.53	21.6	0/20	6.99	6.89	23.5	0/20	6.88	6.22	22	2/20	6.96	5.85	21.5
150 ppm	0/20	7.17	7.48	21.6	2/20	7.04	7.09	23.5	11/20	6.87	6.72	22	14/20	6.97	6.43	21.5
Duplicate	0/20	7.17	7.48	21.6	2/20	7.07	7.02	23.4	4/20	6.96	6.51	22	9/20	7.02	6.3	21.4
1,500 ppm	0/20	7.04	7.41	21.6	14/20	6.93	6.94	23.4	19/20	6.92	6.05	22	19/20	6.98	6.02	21.6
Duplicate	1/20	7.01	7.42	21.7	6/20	6.91	7.02	23.4	16/20	6.95	6.49	22	18/20	7.01	5.94	21.6
15,000 ppm	1/20	6.17	7.4	21.7	16/20	5.82	7.05	23.5	20/20	5.54	6.98	22	20/20	5.63	6.76	21.6
Duplicate	2/20	5.38	7.39	21.7	13/20	5.66	7.11	23.5	19/20	5.43	6.97	22	20/20	5.41	6.72	21.6
AFFF																
3 ppm	0/20	6.98	7.20	22.2	1/20	6.96	6.63	24	1/20	6.94	6.09	22.2	2/20	7.01	5.86	21.6
Duplicate	0/20	6.98	7.24	22.1	0/20	6.94	6.67	24	0/20	6.96	6.3	22.1	0/20	7.00	6.26	21.6
30 ppm	2/20	6.97	7.24	22	4/20	6.92	6.5	23.8	4/20	6.74	5.66	22	4/20	6.77	4.94	21.6
Duplicate	0/20	7.00	7.35	21.9	0/20	6.93	6.84	23.8	0/20	6.72	6.05	22	3/20	6.78	4.97	21.5
300 ppm	0/20	7.26	7.50	21.9	3/20	6.98	6.93	23.7	3/20	6.38	4.51	21.9	20/20	5.33	2.8	21.5
Duplicate	0/20	7.06	7.49	21.9	1/20	6.82	6.93	23.8	1/20	6.25	4.76	22	13/20	4.87	3.54	21.6
3,000 ppm	1/20	7.21	7.44	21.9	2/20	7.08	6.89	23.7	7/20	6.53	3.37	21.9	20/20	5.97	0.29	21.5
Duplicate	1/20	7.11	7.36	21.9	1/20	7.02	6.79	23.8	1/20	6.45	2.56	21.9	20/20	6.04	0.24	21.6
30,000 ppm	20/20	7.51	7.40	22												
Duplicate	20/20	7.46	7.39	22.1												

TEST AGENT: FireAde 2000,
1 August 2003

	t = 0				t = 4				t = 24				t = 48			
	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp
Control 1	0/20	7.25	6.78	22.1	0/20	7.17	6.26	23.9	1/20	7.11	5.75	23	2/20	7.08	5.35	21.7
Control 2	0/20	7.23	6.79	22.2	0/20	7.19	6.28	23.9	0/20	7.12	5.82	23	0/20	7.1	5.82	21.6
Test Agent																
3 ppm	0/20	7.4	6.75	22.4	0/20	7.27	6.32	24.1	1/20	7.16	5.72	23.1	1/20	7.22	5.83	21.7
Duplicate	0/20	7.18	6.76	22.4	1/20	7.07	6.32	24.1	3/20	6.97	5.64	23.1	3/20	7.02	5.85	21.7
30 ppm	0/20	7.23	6.73	22.3	1/20	7.12	6.35	23.9	2/20	6.98	5.47	23	2/20	7.02	5.79	21.6
Duplicate	0/20	7.16	6.76	22.3	0/20	7.04	6.29	23.9	0/20	6.88	5.27	23.1	0/20	6.94	5.71	21.6
300 ppm	16/20	7.12	6.73	22.3	20/20	7.03	6.46	23.8								
Duplicate	19/20	7.3	6.75	22.3	20/20	7.26	6.52	23.9								
3,000 ppm	20/20	7.24	6.78	22.3												
Duplicate	20/20	7.61	6.79	22.3												
30,000 ppm	20/20	7.71	6.83	22.4												
Duplicate	20/20	7.77	6.82	22.4												
AFFF																
3 ppm	0/20	7.32	6.75	22.3	3/20	7.19	6.31	23.9	6/20	7.12	5.8	22.9	7/20	7.19	5.65	21.5
Duplicate	0/20	7.18	6.76	22.2	0/20	7.03	6.35	23.9	2/20	6.98	5.86	22.9	2/20	7.09	5.91	21.5
30 ppm	0/20	6.91	6.74	22.2	1/20	6.89	6.32	23.8	3/20	6.73	5.43	22.8	3/20	6.79	5.14	21.5
Duplicate	0/20	7.06	6.76	22.1	0/20	7	6.25	23.7	0/20	6.82	5.26	22.8	0/20	6.88	5.02	21.4
300 ppm	0/20	6.99	6.76	22.1	0/20	6.88	6.23	23.7	4/20	6.62	3.9	22.8	6/20	6.48	2.53	21.5
Duplicate	0/20	7.06	6.78	22.1	0/20	6.94	6.26	23.7	1/20	6.67	4.34	22.8	1/20	6.41	2.29	21.4
3,000 ppm	0/20	7.2	6.75	22.1	0/20	7.11	6.28	23.7	9/20	6.72	2.64	22.8	20/20	6.54	0.23	21.4
Duplicate	0/20	7.23	6.77	22.1	0/20	7.13	6.25	23.7	1/20	6.73	3.34	22.8	20/20	6.48	0.19	21.4
30,000 ppm	20/20	7.48	6.8	22.2												
Duplicate	20/20	7.47	6.83	22.1												

TEST AGENT: Hawk Allfire,
8 August 2003

t = 0					t = 4					t = 24					t = 48				
	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp			
Control 1	0/20	7.33	6.21	21.8	0/20	7.18	6.1	22.8	0/20	7.14	5.92	21.4	1/20	7.03	5.78	21.8			
Control 2	0/20	7.34	6.23	21.7	0/20	7.21	6.04	22.8	0/20	7.18	5.82	21.5	0/20	7.03	5.67	21.7			
Test Agent																			
3 ppm	0/20	7.31	6.12	21.9	0/20	7.15	6.03	23	0/20	7.02	5.79	21.6	3/20	6.9	5.73	22			
Duplicate	0/20	7.2	6.24	21.9	0/20	7.05	6.07	23	1/20	6.92	5.8	21.6	1/20	6.84	5.66	22.1			
30 ppm	2/20	7.36	6.14	21.9	2/20	7.18	5.97	23	2/20	7.06	5.52	21.6	5/20	6.8	4.56	22			
Duplicate	0/20	7.26	6.14	21.8	3/20	7.08	5.98	23	3/20	6.96	5.6	21.6	5/20	6.69	4.7	22			
300 ppm	20/20	7.11	6.17	21.9															
Duplicate	20/20	7.13	6.17	21.9															
3,000 ppm	20/20	7.16	6.14	21.9															
Duplicate	20/20	7.27	6.17	21.9															
30,000 ppm	20/20	7.77	6.18	22															
Duplicate	20/20	7.85	6.18	21.9															
AFFF																			
3 ppm	0/20	7.26	6.25	22	0/20	7.18	6.1	22.8	0/20	7.16	5.87	21.4	3/20	7.02	5.69	21.7			
Duplicate	0/20	7.26	6.14	21.9	0/20	7.12	5.99	22.7	2/20	7.1	5.74	21.4	4/20	6.99	5.46	21.7			
30 ppm	1/20	7.28	6.14	21.9	3/20	7.14	6.08	22.7	4/20	6.92	5.65	21.3	4/20	6.79	4.82	21.7			
Duplicate	0/20	7.04	6.12	21.8	2/20	6.89	5.98	22.8	5/20	6.69	5.49	21.3	5/20	6.54	4.24	21.7			
300 ppm	0/20	7.07	6.13	21.9	0/20	6.97	6.05	22.7	1/20	6.74	5.54	21.3	3/20	6.17	2.75	21.5			
Duplicate	0/20	6.99	6.17	21.8	1/20	6.91	6.08	22.8	1/20	6.68	5.12	21.3	1/20	6.02	2.59	21.7			
3,000 ppm	1/20	7.27	6.13	21.9	1/20	7.19	6.06	22.8	7/20	6.98	5.34	21.3	20/20	6.28	0.28	21.7			
Duplicate	0/20	7.26	6.17	21.8	0/20	7.19	6.02	22.8	3/20	6.94	5.04	21.3	20/20	6.26	0.21	21.7			
30,000 ppm	20/20	7.55	6.21	21.9															
Duplicate	20/20	7.52	6.28	21.9															

TEST AGENT: EarthSorb,
19 Dec 2003

	t = 0				t = 4				t = 24				t = 48			
	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp
Control 1	0/20	6.71		19.3	0/20		8.50		0/20	6.16	8.44	19.0	1/20	6.67	8.55	18.1
Control 2	0/20	6.61		19.3	0/20		8.44		0/20	6.07	8.42	18.8	0/20	6.57	8.43	17.9
Test Agent																
0.0005g/L	0/20	6.64		19.0	0/20		9.83		0/20	6.50	8.45	18.7	1/20	6.40	8.56	18.1
Duplicate	0/20	6.65		19.1	0/20		9.87		0/20	6.66	8.49	18.7	0/20	6.47	8.62	18.1
0.005g/L	0/20	6.70		19.2	0/20		9.73		0/20	6.72	8.35	18.6	0/20	6.56	8.51	18.0
Duplicate	0/20	6.71		19.1	0/20		8.51		0/20	6.69	8.12	18.6	0/20	6.60	8.30	18.0
0.05g/L	0/20	6.72		19.2	0/20		8.41		0/20	6.49	5.94	18.6	0/20	6.49	4.00	18.1
Duplicate	0/20	6.66		19.2	0/20		8.35		0/20	6.37	5.78	18.6	0/20	6.38	4.33	18.0
0.5g/L	0/20	6.78		19.2	0/20		8.20		0/20	6.29	2.29	18.7	0/20	6.30	0.15	18.1
Duplicate	0/20	6.65		19.2	0/20		8.38		0/20	6.14	1.33	18.7	0/20	6.13	0.15	18.1
5g/L	0/20	6.75		19.2	0/20		8.25		0/20	6.02	0.14	18.9	11/20	5.34	0.03	18.2
Duplicate	0/20	6.75		19.1	0/20		8.15		0/20	5.78	0.10	18.9	14/20	5.28	0.03	18.2
AFFF																
3 ppm	0/20	6.23		20.3	0/20		8.47		0/20	6.25	8.34	19.0	0/20	6.68	8.40	18.0
Duplicate	0/20	6.22		20.3	0/20		8.43		0/20	6.23	8.39	18.9	0/20	6.59	8.40	18.0
30 ppm	0/20	6.26		20.4	0/20		8.50		0/20	6.29	8.37	19.0	0/20	6.59	8.45	18.1
Duplicate	0/20	6.32		20.3	0/20		8.50		0/20	6.30	8.56	18.9	0/20	6.59	8.61	18.0
300 ppm	0/20	6.20		20.4	0/20		8.52		0/20	6.16	8.42	19.0	0/20	6.18	8.00	18.2
Duplicate	0/20	6.13		20.3	0/20		8.42		0/20	6.15	8.30	18.9	0/20	6.01	7.95	18.1
3,000 ppm	0/20	6.38		20.4	20/20		8.55		20/20				20/20			
Duplicate	0/20	6.23		20.3	20/20		8.54		20/20				20/20			
30,000 ppm	20/20	6.45		20.4	20/20		8.59		20/20				20/20			
Duplicate	20/20	6.63		20.3	20/20		8.65		20/20				20/20			

TEST AGENT: Hawk Super B
12 Dec 2003

	t = 0				t = 4				t = 24				t = 48			
	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp
Control 1	0/20	6.71		19.3	0/20		8.50		0/20	6.16	8.44	19.0	1/20	6.67	8.55	18.1
Control 2	0/20	6.61		19.3	0/20		8.44		0/20	6.07	8.42	18.8	0/20	6.57	8.43	17.9
Test Agent																
6 ppm	0/20	6.48		20.4	0/20		8.26		0/20	6.31	8.19	19.2	0/20	6.39	8.26	18.3
Duplicate	0/20	6.63		20.3	0/20		8.38		0/20	6.51	8.42	19.0	1/20	6.55	8.29	18.2
60 ppm	0/20	6.80		20.3	20/20		8.55		20/20				20/20			
Duplicate	0/20	6.72		20.2	20/20		8.47		20/20				20/20			
600 ppm	20/20	6.46		20.4	20/20		8.55		20/20				20/20			
Duplicate	20/20	6.51		20.2	20/20		8.59		20/20				20/20			
6,000 ppm	20/20	6.68		20.1	20/20		8.65		20/20				20/20			
Duplicate	20/20	6.76		20.2	20/20		8.69		20/20				20/20			
60,000 ppm	20/20	6.95		20.1	20/20		8.70		20/20				20/20			
Duplicate	20/20	7.18		19.8	20/20		8.70		20/20				20/20			
AFFF																
3 ppm	0/20	7.06	8.41	21.4					0/20	7.00	5.58	19.5	0/20	6.80	5.50	20.6
Duplicate	0/20	6.84	8.44	21.4					0/20	7.10	5.54	19.2	0/20	6.70	5.45	20.5
30 ppm	0/20	6.77		21.4					0/20	6.70	5.58	19.3	0/20	6.80	5.51	20.7
Duplicate	0/20	6.38		21.4					0/20	6.80	5.58	19.2	0/20	6.90	5.51	20.5
300 ppm	0/20	6.41		21.3					0/20	6.60	5.32	19.3	0/20	6.80	5.11	20.7
Duplicate	0/20	6.37		21.4					0/20	6.60	5.35	19.2	0/20	6.80	5.05	20.5
3,000 ppm	0/20	6.11		21.1					20/20	6.60	5.02	19.1	20/20			
Duplicate	0/20	6.23		21.1					20/20	6.60	5.52	19.2	20/20			
30,000 ppm	20/20	6.47		21.3					20/20	6.90	5.67	19.3	20/20			
Duplicate	20/20	6.71		21.4					20/20	7.00	5.76	19.2	20/20			

TEST AGENT: Micro
BlazeOut +,
12 Dec 2003

t = 0				t = 4				t = 24				t = 48				
	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp	Mortality	pH	DO	Temp
Control 1	0/20	6.64	8.40	21.6	0/20				4/20	6.10	5.60	19.7	8/20	7.10	5.59	21.0
Control 2	0/20	6.54	8.40	21.6	0/20				11/20	6.00	5.62	19.5	20/20	6.80	5.58	21.0
Test Agent																
6 ppm	0/20	7.38		21.2	0/20				0/20	7.00	5.55	19.3	0/20	7.10	5.54	20.7
Duplicate	0/20	7.24		21.3	0/20				0/20	6.90	5.75	19.2	0/20	7.00	5.49	20.5
60 ppm	0/20	7.07		21.2	0/20				0/20	6.90	5.55	19.2	0/20	6.90	5.50	20.6
Duplicate	0/20	6.90		21.3	0/20				0/20	6.80	5.65	19.1	0/20	6.90	5.50	20.6
600 ppm	0/20	6.79		21.2	0/20				0/20	6.70	5.51	19.2	0/20	6.80	5.17	20.6
Duplicate	0/20	6.60		21.2	0/20				0/20	6.50	5.51	19.1	0/20	6.80	5.23	20.6
6,000 ppm	0/20	6.54		21.2	8/20				20/20	6.60	5.36	19.0	20/20			
Duplicate	0/20	6.62		21.2	8/20				20/20	6.60	5.58	19.1	20/20			
60,000 ppm	0/20	6.36		21.2	20/20				20/20	6.60	5.74	19.2	20/20			
Duplicate	0/20	6.39		21.2	20/20				20/20	6.60	5.78	19.1	20/20			
AFFF																
3 ppm	0/20	7.06	8.41	21.4					0/20	7.00	5.58	19.5	0/20	6.80	5.50	20.6
Duplicate	0/20	6.84	8.44	21.4					0/20	7.10	5.54	19.2	0/20	6.70	5.45	20.5
30 ppm	0/20	6.77		21.4					0/20	6.70	5.58	19.3	0/20	6.80	5.51	20.7
Duplicate	0/20	6.38		21.4					0/20	6.80	5.58	19.2	0/20	6.90	5.51	20.5
300 ppm	0/20	6.41		21.3					0/20	6.60	5.32	19.3	0/20	6.80	5.11	20.7
Duplicate	0/20	6.37		21.4					0/20	6.60	5.35	19.2	0/20	6.80	5.05	20.5
3,000 ppm	0/20	6.11		21.1					20/20	6.60	5.02	19.1	20/20			
Duplicate	0/20	6.23		21.1					20/20	6.60	5.52	19.2	20/20			
30,000 ppm	20/20	6.47		21.3					20/20	6.90	5.67	19.3	20/20			
Duplicate	20/20	6.71		21.4					20/20	7.00	5.76	19.2	20/20			

**APPENDIX C: SAMPLE OUTPUT DATA PRODUCED BY TIDEPOOL SCIENTIFIC
TOXCALC™ BIOASSAY CALCULATOR SOFTWARE**

AQUATIC TOXICITY TEST – FLAMEOUT II

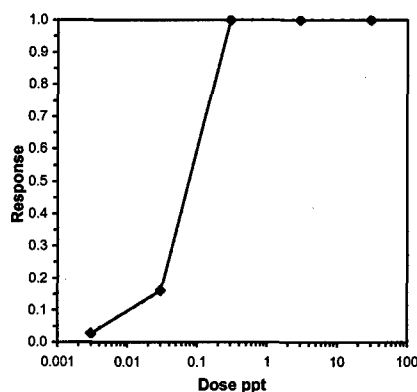
DATE: 18 June 03

Acute Fish Test-48 Hr Survival					
Start Date:	6/18/2003	Test ID:	1	Sample ID:	Flame Out II
End Date:	6/20/2003	Lab ID:	Air Force Research Lab	Sample Type:	Fire Fighting Foam
Sample Dat		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:					
Conc-ppt	1	2			
B-Control	0.9000	0.9500			
0.003	0.9500	0.8500			
0.03	0.7500	0.8000			
0.3	0.0000	0.0000			
3	0.0000	0.0000			
30	0.0000	0.0000			

Transform: Arcsin Square Root								Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9250	1.0000	1.2972	1.2490	1.3453	5.246	2	3	40
0.003	0.9000	0.9730	1.2592	1.1731	1.3453	9.669	2	4	40
0.03	0.7750	0.8378	1.0772	1.0472	1.1071	3.935	2	9	40
0.3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Primary Tests				Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed							
Bartlett's Test indicates equal variances (p = 0.69)				0.7327135	9.210351		
Trimmed Spearman-Kärber							
Trim Level	EC50	95% CL					
0.0%							
5.0%	0.0687	0.0506	0.0932				
10.0%	0.0733	0.0500	0.1075				
20.0%	0.0759	0.0627	0.0919				
Auto-2.7%	0.0661	0.0495	0.0884				

Trim Level	EC50	95% CL Lower	95% CL Upper
0.0%			
5.0%	0.0687	0.0506	0.0932
10.0%	0.0733	0.0500	0.1075
20.0%	0.0759	0.0627	0.0919
Auto-2.7%	0.0661	0.0495	0.0884



AQUATIC TOXICITY TEST – FIREADE 2000

DATE: 20 June 03

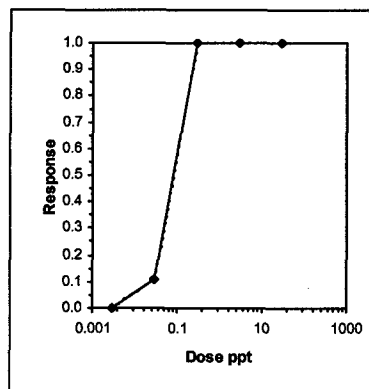
Acute Fish Test-48 Hr Survival			
Start Date: 6/18/2003	Test ID: 1	Sample ID: Fire Ade 2000	
End Date: 6/20/2003	Lab ID: Air Force Research Lab	Sample Type: Fire Fighting Foam	
Sample Dat	Protocol: EPAA 91-EPA Acute	Test Species: PP-Pimephales promelas	

Conc-ppt	1	2
B-Control	0.9000	0.9500
0.003	0.9000	0.9500
0.03	0.7000	0.9500
0.3	0.0000	0.0000
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number Resp	Total Number
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N		
B-Control	0.9250	1.0000	1.2972	1.2490	1.3453	5.246	2	3	40
0.003	0.9250	1.0000	1.2972	1.2490	1.3453	5.246	2	3	40
0.03	0.8250	0.8919	1.1682	0.9912	1.3453	21.435	2	7	40
0.3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Auditory Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Bartlett's Test indicates equal variances (p = 0.45)	1.6122549	9.210351		

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%	0.0740	0.0590	0.0927
5.0%	0.0797	0.0603	0.1052
10.0%	0.0824	0.0552	0.1232
20.0%	0.0825	0.0716	0.0951
Auto-0.0%	0.0740	0.0590	0.0927



AQUATIC TOXICITY TEST – PS B-25

DATE: 27 June 03

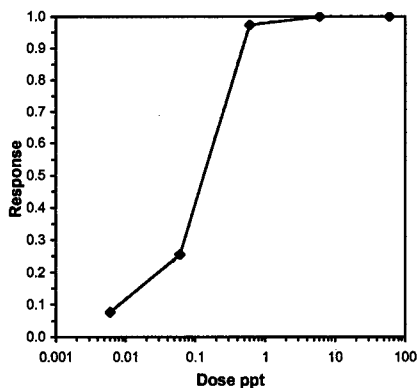
Acute Fish Test-48 Hr Survival					
Start Date:	6/25/2003	Test ID:	1	Sample ID:	PS B-25
End Date:	6/27/2003	Lab ID:	Air Force Research Lab	Sample Type:	Fire Fighting Foam
Sample Dat		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:					

Conc-ppt	1	2
B-Control	0.9500	1.0000
0.006	0.9000	0.9000
0.06	0.8000	0.6500
0.6	0.0500	0.0000
6	0.0000	0.0000
60	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9750	1.0000	1.4020	1.3453	1.4588	5.723	2	1	40
0.006	0.9000	0.9231	1.2490	1.2490	1.2490	0.000	2	4	40
0.06	0.7250	0.7436	1.0224	0.9377	1.1071	11.716	2	11	40
0.6	0.0250	0.0256	0.1688	0.1120	0.2255	47.542	2	39	40
6	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
60	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Statistical Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%	0.1131	0.0748	0.1710
20.0%	0.1277	0.0673	0.2426
Auto-7.7%	0.1091	0.0734	0.1622



AQUATIC TOXICITY TEST – TDA 555-8

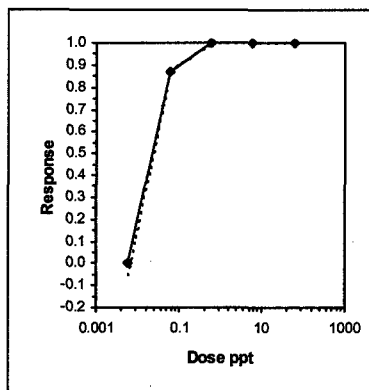
DATE: 18 July 03

Acute Fish Test-48 Hr Survival					
Start Date:	7/16/2003	Test ID:	1	Sample ID:	TDA 555-8
End Date:	7/18/2003	Lab ID:	Air Force Research Lab	Sample Type:	Fire Fighting Foam
Sample Dat		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:					
Conc-ppt	1	2			
B-Control	0.9000	1.0000			
0.006	1.0000	1.0000			
0.06	0.2500	0.0000			
0.6	0.0000	0.0000			
6	0.0000	0.0000			
60	0.0000	0.0000			

Transform: Arcsin Square Root								Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9500	1.0000	1.3539	1.2490	1.4588	10.953	2	2	40
0.006	1.0000	1.0526	1.4588	1.4588	1.4588	0.000	2	0	40
0.06	0.1250	0.1316	0.3178	0.1120	0.5236	91.567	2	35	40
0.6	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
6	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
60	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CI	
0.0%	0.0255	0.0200	0.0325
5.0%	0.0237	0.0184	0.0304
10.0%	0.0226	0.0183	0.0280
20.0%	0.0225	0.0191	0.0264
Auto-0.0%	0.0255	0.0200	0.0325




AQUATIC TOXICITY TEST – TDA 541-3

DATE: 18 July 03

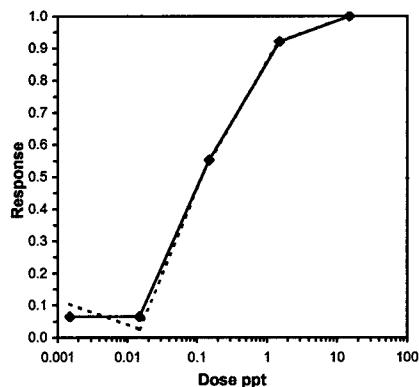
Acute Fish Test-48 Hr Survival			
Start Date: 7/16/2003	Test ID: 1	Sample ID: TDA 541-3	
End Date: 7/18/2003	Lab ID: Air Force Research Lab	Sample Type: Fire Fighting Foam	
Sample Dat	Protocol: EPAA 91-EPA Acute	Test Species: PP-Pimephales promelas	
Comments:			
Conc-ppt	1	2	
B-Control	0.9000	1.0000	
0.0015	0.8000	0.9000	
0.015	0.9500	0.9000	
0.15	0.3000	0.5500	
1.5	0.0500	0.1000	
15	0.0000	0.0000	

Transform: Arcsin Square Root								Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9500	1.0000	1.3539	1.2490	1.4588	10.953	2	2	40
0.0015	0.8500	0.8947	1.1781	1.1071	1.2490	8.517	2	6	40
0.015	0.9250	0.9737	1.2972	1.2490	1.3453	5.246	2	3	40
0.15	0.4250	0.4474	0.7076	0.5796	0.8355	25.568	2	23	40
1.5	0.0750	0.0789	0.2736	0.2255	0.3218	24.869	2	37	40
15	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Auxiliary Tests		Statistic		Critical	Skew	Kurt
Normality of the data set cannot be confirmed						
Bartlett's Test indicates equal variances (p = 0.90)		1.0876513		13.276698		
Trimmed Spearman-Kärber						
Trim Level	EC50	95% CL				
0.0%						
5.0%						
10.0%	0.1312	0.0815	0.2111			
20.0%	0.1264	0.0691	0.2311			
Auto-6.6%	0.1331	0.0845	0.2097			



The plot displays a sigmoidal curve representing the cumulative distribution function. The y-axis ranges from 0.9 to 1.0. Three data points are plotted: at 10.0% trim level (EC50 = 0.1312, 95% CL = [0.0815, 0.2111]), at 20.0% trim level (EC50 = 0.1264, 95% CL = [0.0691, 0.2311]), and at the Auto-6.6% trim level (EC50 = 0.1331, 95% CL = [0.0845, 0.2097]). The curve is smooth and passes through these points.



AQUATIC TOXICITY TEST – FIREADE 2000

DATE: 1 August 03

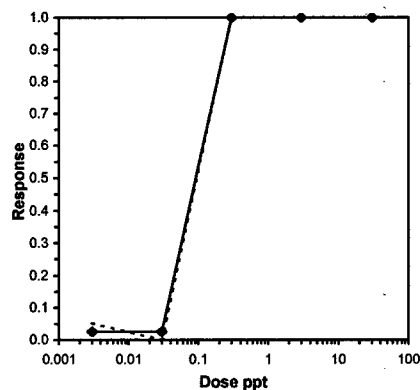
Acute Fish Test-48 Hr Survival					
Start Date:	7/30/2003	Test ID:	1	Sample ID:	Fire Ade 2000
End Date:	8/1/2003	Lab ID:	Air Force Research Lab	Sample Type:	Fire Fighting Foam
Sample Dat		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:					

Conc-ppt	1	2
B-Control	0.9000	1.0000
0.003	0.9500	0.8500
0.03	0.9000	1.0000
0.3	0.0000	0.0000
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9500	1.0000	1.3539	1.2490	1.4588	10.953	2	2	40
0.003	0.9000	0.9474	1.2592	1.1731	1.3453	9.669	2	4	40
0.03	0.9500	1.0000	1.3539	1.2490	1.4588	10.953	2	2	40
0.3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Bartlett's Test indicates equal variances (p = 0.98)	0.034177	9.210351		

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%			
5.0%	0.0920	0.0865	0.0978
10.0%	0.0920	0.0865	0.0978
20.0%	0.0920	0.0865	0.0978
Auto-2.6%	0.0920	0.0865	0.0978



AQUATIC TOXICITY TEST – HAWK ALLFIRE

DATE: 8 August 03

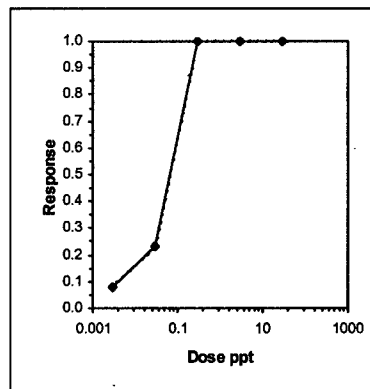
Acute Fish Test-48 Hr Survival			
Start Date: 8/6/2003	Test ID: 1	Sample ID: Hawk Allfire	
End Date: 8/8/2003	Lab ID: Air Force Research Lab	Sample Type: Fire Fighting Foam	
Sample Date	Protocol: EPAA 91-EPA Acute	Test Species: PP-Pimephales promelas	

Conc-ppt	1	2
B-Control	0.9500	1.0000
0.003	0.8500	0.9500
0.03	0.7500	0.7500
0.3	0.0000	0.0000
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9750	1.0000	1.4020	1.3453	1.4588	5.723	2	1	40
0.003	0.9000	0.9231	1.2592	1.1731	1.3453	9.669	2	4	40
0.03	0.7500	0.7692	1.0472	1.0472	1.0472	0.000	2	10	40
0.3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Normality Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CI	
0.0%			
5.0%			
10.0%	0.0591	0.0398	0.0877
20.0%	0.0665	0.0345	0.1284
Auto-7.7%	0.0568	0.0389	0.0829



AQUATIC TOXICITY TEST - EARTHSORB

DATE: 19 December 03

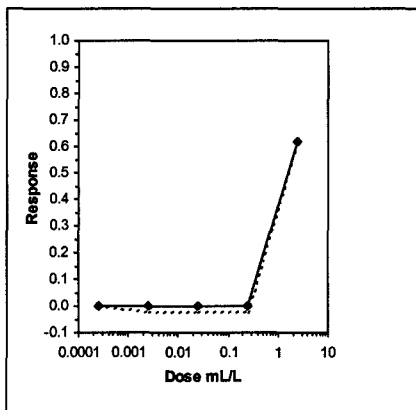
Acute Fish Test-48 Hr Survival				
Start Date: 12/17/2004	Test ID: EarthSorb	Sample ID:	REF-Ref Toxicant	
End Date: 12/19/2004	Lab ID: Air Force Research Laboratory	Sample Type:	Fire Fighting Agent	
Sample Date: 12/17/2004	Protocol: EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas	
Comments: Powdered Pinto Beans				

Conc-m/L	1	2
B-Control	0.9500	1.0000
0.00025	0.9500	1.0000
0.0025	1.0000	1.0000
0.025	1.0000	1.0000
0.25	1.0000	1.0000
2.5	0.4500	0.3000

Transform: Arcsin Square Root								Number	Total
Conc-m/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9750	1.0000	1.4020	1.3453	1.4588	5.723	2	1	40
0.00025	0.9750	1.0000	1.4020	1.3453	1.4588	5.723	2	1	40
0.0025	1.0000	1.0256	1.4588	1.4588	1.4588	0.000	2	0	40
0.025	1.0000	1.0256	1.4588	1.4588	1.4588	0.000	2	0	40
0.25	1.0000	1.0256	1.4588	1.4588	1.4588	0.000	2	0	40
2.5	0.3750	0.3846	0.6575	0.5796	0.7353	16.743	2	25	40

Auxiliary Tests				Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed							
Equality of variance cannot be confirmed							

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CI	
0.0%			
5.0%			
10.0%			
20.0%			
Auto-37.9%	1.5952	1.0094	2.5210



Auxiliary Data Summary							
Conc-m/L	Parameter	Mean	Min	Max	SD	CV%	N
S-Control	Temp C	18.00	17.90	18.10	0.14	2.09	2
0.0005		18.10	18.10	18.10	0.00	0.00	2
0.005		18.00	18.00	18.00	0.00	0.00	2
0.05		18.05	18.00	18.10	0.07	1.47	2
0.5		18.10	18.10	18.10	0.00	0.00	2
5		18.20	18.20	18.20	0.00	0.00	2
S-Control	pH	6.62	6.57	6.67	0.07	4.02	2
0.0005		6.44	6.40	6.47	0.05	3.46	2
0.005		6.58	6.56	6.60	0.03	2.56	2
0.05		6.44	6.38	6.49	0.08	4.33	2
0.5		6.22	6.13	6.30	0.12	5.58	2
5		5.31	5.28	5.34	0.04	3.88	2
S-Control	DO mg/L	8.49	8.43	8.55	0.08	3.43	2
0.0005		8.59	8.56	8.62	0.04	2.40	2
0.005		8.41	8.30	8.51	0.15	4.58	2
0.05		4.17	4.00	4.33	0.23	11.60	2
0.5		0.15	0.15	0.15	0.00	0.00	2
5		0.03	0.03	0.03	0.00	0.00	2

AQUATIC TOXICITY TEST – HAWK SUPER B

DATE: 12 December 03

Acute Fish Test-48 Hr Survival				
Start Date: 12/10/2004	Test ID: HawkSuper	Sample ID:	REF-Ref Toxicant	
End Date: 12/12/2004	Lab ID: Air Force Research Laboratory	Sample Type:	Fire Fighting Agent	
Sample Dat 12/10/2004	Protocol: EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas	
Comments: Liquid				

Conc-ppm	1	2
B-Control	1.0000	1.0000
0.003	1.0000	1.0000
0.03	0.0000	0.0000
0.3	0.0000	0.0000
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number
Conc-ppm	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp
B-Control	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0
0.003	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0
0.03	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40
0.3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40

Auxiliary Tests	Statistic	Critical	Skew
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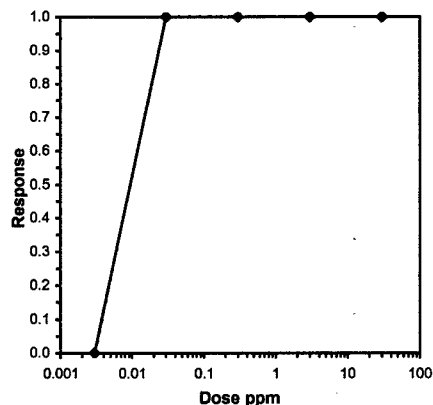
Normality of the data set cannot be confirmed

Equality of variance cannot be confirmed

Graphical Method	
Trim Level	EC50

0.0% 0.0095

0.0095



Auxiliary Data Summary							
Conc-ppm	Parameter	Mean	Min	Max	SD	CV%	N
S-Control	Temp C	18.00	17.90	18.10	0.14	2.09	2
0.0005		18.25	18.20	18.30	0.07	1.46	2
0.005		0.00	0.00	0.00	0.00		0
0.05		0.00	0.00	0.00	0.00		0
0.5		0.00	0.00	0.00	0.00		0
5		0.00	0.00	0.00	0.00		0
S-Control	pH	6.62	6.57	6.67	0.07	4.02	2
0.0005		6.46	6.36	6.55	0.13	5.68	2
0.005		0.00	0.00	0.00	0.00		0
0.05		0.00	0.00	0.00	0.00		0
0.5		0.00	0.00	0.00	0.00		0
5		0.00	0.00	0.00	0.00		0
S-Control	DO mg/L	8.49	8.43	8.55	0.08	3.43	2
0.0005		8.28	8.26	8.29	0.02	1.76	2
0.005		0.00	0.00	0.00	0.00		0
0.05		0.00	0.00	0.00	0.00		0
0.5		0.00	0.00	0.00	0.00		0
5		0.00	0.00	0.00	0.00		0

AQUATIC TOXICITY TEST – MICRO BLAZEOUT +

DATE: 12 December 03

Acute Fish Test-48 Hr Survival				
Start Date: 12/10/2003	Test ID: BlazeOut+	Sample ID:	REF-Ref Toxicant	
End Date: 12/12/2003	Lab ID: Air Force Research Laboratory	Sample Type:	Fire Fighting Agent	
Sample Dat 12/10/2003	Protocol: EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas	
Comments:				

Conc-m/L	1	2
B-Control	1.0000	1.0000
0.003	1.0000	1.0000
0.03	1.0000	1.0000
0.3	1.0000	1.0000
3	0.0000	0.0000
30	0.0000	0.0000

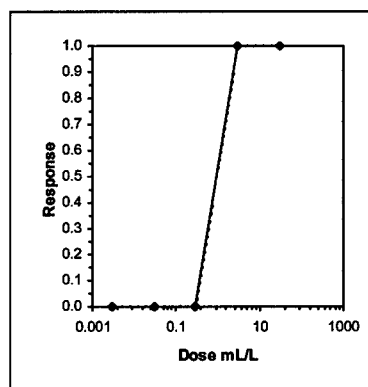
Transform: Arcsin Square Root								Number	Total
Conc-m/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0	40
0.003	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0	40
0.03	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0	40
0.3	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Graphical Method	
EC50	0.9487

0.0% 0.9487

0.9487



Auxiliary Data Summary							
Conc-m/L	Parameter	Mean	Min	Max	SD	CV%	N
S-Control	Temp C	21.00	21.00	21.00	0.00	0.00	2
0.0005		20.60	20.50	20.70	0.14	1.83	2
0.005		20.60	20.60	20.60	0.00	0.00	2
0.05		20.60	20.60	20.60	0.00	0.00	2
0.5		0.00	0.00	0.00	0.00	0.00	0
5		0.00	0.00	0.00	0.00	0.00	0
S-Control	pH	6.95	6.80	7.10	0.21	6.63	2
0.0005		7.05	7.00	7.10	0.07	3.77	2
0.005		6.90	6.90	6.90	0.00	0.00	2
0.05		6.80	6.80	6.80	0.00	0.00	2
0.5		0.00	0.00	0.00	0.00	0.00	0
5		0.00	0.00	0.00	0.00	0.00	0
S-Control	DO mg/L	5.59	5.58	5.59	0.01	1.51	2
0.0005		5.52	5.49	5.54	0.04	3.41	2
0.005		5.50	5.50	5.50	0.00	0.00	2
0.05		5.20	5.17	5.23	0.04	3.96	2
0.5		0.00	0.00	0.00	0.00	0.00	0
5		0.00	0.00	0.00	0.00	0.00	0

**APPENDIX D: AFFF OUTPUT DATA PRODUCED BY TIDEPOOL SCIENTIFIC
TOXCALC™ BIOASSAY CALCULATOR SOFTWARE**

AQUATIC TOXICITY TEST – 3M AFFF

DATE: 20 June 03

Acute Fish Test-48 Hr Survival			
Start Date: 6/25/2003	Test ID: AFFF	Sample ID:	REF-Ref Toxicant
End Date: 6/27/2003	Lab ID: Air Force Research Laboratory	Sample Type:	Fire Fighting Agent
Sample Date: 6/25/2003	Protocol: EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas

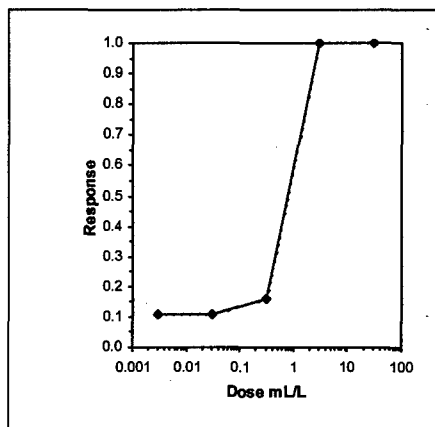
Comments:

Conc-mL/L	1	2
B-Control	0.9000	0.9500
0.003	0.8500	0.8000
0.03	0.8500	0.8000
0.3	0.9500	0.6000
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc-mL/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9250	1.0000	1.2972	1.2490	1.3453	5.246	2	3	40
0.003	0.8250	0.8919	1.1401	1.1071	1.1731	4.090	2	7	40
0.03	0.8250	0.8919	1.1401	1.1071	1.1731	4.090	2	7	40
0.3	0.7750	0.8378	1.1157	0.8861	1.3453	29.104	2	9	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Bartlett's Test indicates equal variances (p = 0.26)	4.0021081	11.344882		

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%	0.7592	0.6271	0.9191
Auto-10.8%	0.7048	0.4874	1.0193



AQUATIC TOXICITY TEST – 3M AFFF

DATE: 27 June 03

Acute Fish Test-48 Hr Survival			
Start Date: 6/25/2003	Test ID: AFFF	Sample ID:	REF-Ref Toxicant
End Date: 6/27/2003	Lab ID: Air Force Research Laboratory	Sample Type:	Fire Fighting Agent
Sample Date: 6/25/2003	Protocol: EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas

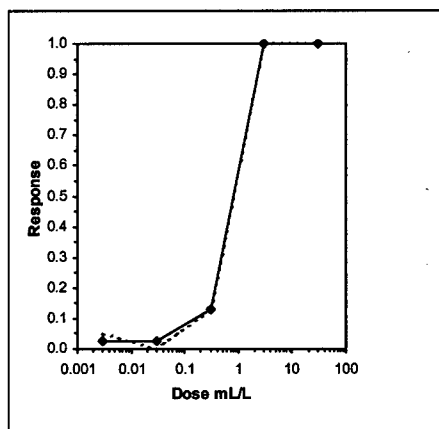
Comments:

Conc. ml/L	1	2
B-Control	0.9500	1.0000
0.003	0.9000	0.9500
0.03	1.0000	0.9500
0.3	0.8500	0.8500
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc. ml/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9750	1.0000	1.4020	1.3453	1.4588	5.723	2	1	40
0.003	0.9250	0.9487	1.2972	1.2490	1.3453	5.246	2	3	40
0.03	0.9750	1.0000	1.4020	1.3453	1.4588	5.723	2	1	40
0.3	0.8500	0.8718	1.1731	1.1731	1.1731	0.000	2	6	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CI	
0.0%			
5.0%	0.7488	0.5658	0.9909
10.0%	0.7931	0.5411	1.1624
20.0%	0.8009	0.6824	0.9400
Auto-2.6%	0.7176	0.5514	0.9340



AQUATIC TOXICITY TEST – 3M AFFF

DATE: 18 July 03

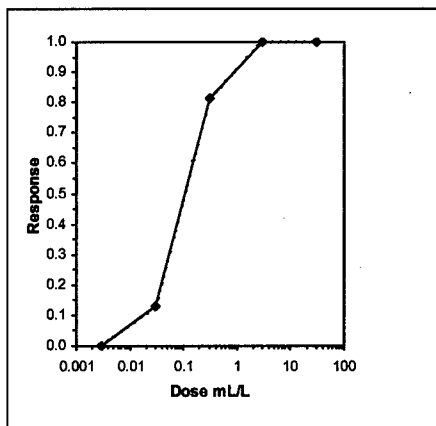
Acute Fish Test-48 Hr Survival			
Start Date: 7/16/2003	Test ID: AFFF	Sample ID:	REF-Ref Toxicant
End Date: 7/18/2003	Lab ID: Air Force Research Laboratory	Sample Type:	Fire Fighting Agent
Sample Date: 7/18/2003	Protocol: EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:			

Conc. mL/L	1	2
B-Control	0.9000	1.0000
0.003	0.9000	1.0000
0.03	0.8000	0.8500
0.3	0.0000	0.3500
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root							Number	Total
Conc. mL/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Number
B-Control	0.9500	1.0000	1.3539	1.2490	1.4588	10.953	2	40
0.003	0.9500	1.0000	1.3539	1.2490	1.4588	10.953	2	40
0.03	0.8250	0.8684	1.1401	1.1071	1.1731	4.090	2	40
0.3	0.1750	0.1842	0.3725	0.1120	0.6331	98.891	2	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40

Normality Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Bartlett's Test indicates equal variances (p = 0.49)	2.3997269	11.344882		

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%	0.1071	0.0736	0.1557
5.0%	0.1078	0.0727	0.1599
10.0%	0.1070	0.0738	0.1552
20.0%	0.1037	0.0785	0.1368
Auto-0.0%	0.1071	0.0736	0.1557



AQUATIC TOXICITY TEST – 3M AFFF

DATE: 1 August 03

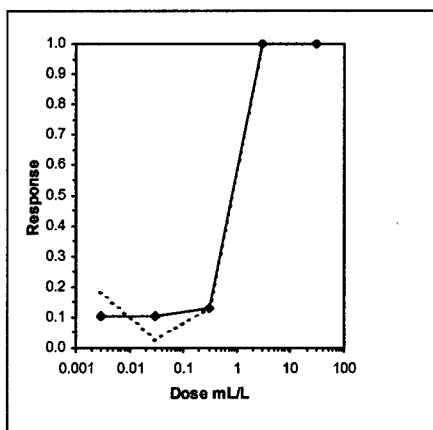
Acute Fish Test-48 Hr Survival				
Start Date: 7/30/2003	Test ID: AFFF	Sample ID:	REF-Ref Toxicant	
End Date: 8/1/2003	Lab ID: Air Force Research Laboratory	Sample Type:	Fire Fighting Agent	
Sample Dat 7/30/2003	Protocol: EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas	
Comments:				

Conc-mL/L	1	2
B-Control	0.9000	1.0000
0.003	0.6500	0.9000
0.03	0.8500	1.0000
0.3	0.7000	0.9500
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc-mL/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9500	1.0000	1.3539	1.2490	1.4588	10.953	2	2	40
0.003	0.7750	0.8158	1.0934	0.9377	1.2490	20.132	2	9	40
0.03	0.9250	0.9737	1.3159	1.1731	1.4588	15.350	2	3	40
0.3	0.8250	0.8684	1.1682	0.9912	1.3453	21.435	2	7	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Normality Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Bartlett's Test indicates equal variances (p = 0.98)	0.1916706	11.344882		

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%	0.7968	0.6769	0.9381
Auto-10.5%	0.7677	0.5463	1.0789



AQUATIC TOXICITY TEST – 3M AFFF

DATE: 8 August 03

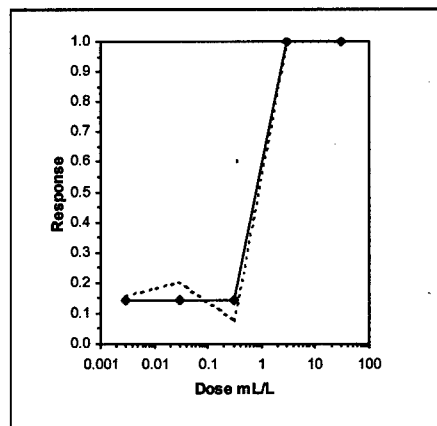
Acute Fish Test-48 Hr Survival					
Start Date:	8/6/2003	Test ID:	AFFF	Sample ID:	REF-Ref Toxicant
End Date:	8/8/2003	Lab ID:	Air Force Research Laboratory	Sample Type:	Fire Fighting Agent
Sample Dat	8/6/2003	Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:					

Conc. mL/L	1	2
B-Control	0.9500	1.0000
0.003	0.8500	0.8000
0.03	0.8000	0.7500
0.3	0.8500	0.9500
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc. mL/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9750	1.0000	1.4020	1.3453	1.4588	5.723	2	1	40
0.003	0.8250	0.8462	1.1401	1.1071	1.1731	4.090	2	7	40
0.03	0.7750	0.7949	1.0772	1.0472	1.1071	3.935	2	9	40
0.3	0.9000	0.9231	1.2592	1.1731	1.3453	9.669	2	4	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Bartlett's Test indicates equal variances (p = 0.80)	1.0207615	11.344882		

Trim Level	EC50	95% CL		Trimmed Spearman-Kärber
0.0%				
5.0%				
10.0%				
20.0%	0.7800	0.6544	0.9298	
Auto-14.5%	0.7800	0.6544	0.9298	



AQUATIC TOXICITY TEST – ANSUL AFFF

DATE: 12 December 03

Acute Fish Test-48 hr Survival				
Start Date: 12/10/2003	Test ID: AFFF	Sample ID:	REF-Ref Toxicant	
End Date: 12/12/2003	Lab ID: Air Force Research Laboratory	Sample Type:	Fire Fighting Agent	
Sample Date: 12/10/2003	Protocol: EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas	

Comments:

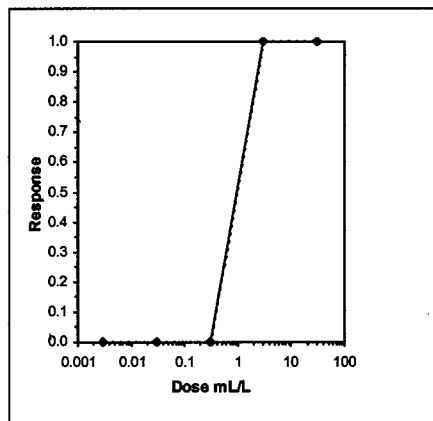
Conc. mL/L	1	2
B-Control	1.0000	1.0000
0.003	1.0000	1.0000
0.03	1.0000	1.0000
0.3	1.0000	1.0000
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc. mL/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0	40
0.003	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0	40
0.03	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0	40
0.3	1.0000	1.0000	1.4588	1.4588	1.4588	0.000	2	0	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Readiness Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Graphical Method	
Trim Level	EC50
0.0%	0.9487

0.9487



AQUATIC TOXICITY TEST - ANSUL AFFF

DATE: 19 December 03

Acute Fish Test-48 Hr Survival				
Start Date: 12/17/2003	Test ID: AFFF	Sample ID: REF-Ref Toxicant		
End Date: 12/19/2003	Lab ID: Air Force Research Laboratory	Sample Type: Fire Fighting Agent		
Sample Date: 12/17/2003	Protocol: EPA 91-EPA Acute	Test Species: PP-Pimephales promelas		

Comments:

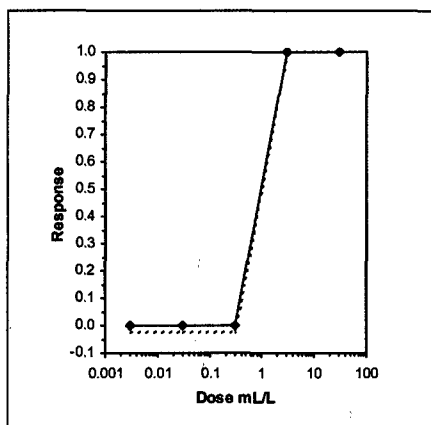
Conc. mL/L	1	2
B-Control	0.9500	1.0000
0.003	1.0000	1.0000
0.03	1.0000	1.0000
0.3	1.0000	1.0000
3	0.0000	0.0000
30	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc. mL/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
B-Control	0.9750	1.0000	1.4020	1.3453	1.4588	5.723	2	1	40
0.003	1.0000	1.0256	1.4588	1.4588	1.4588	0.000	2	0	40
0.03	1.0000	1.0256	1.4588	1.4588	1.4588	0.000	2	0	40
0.3	1.0000	1.0256	1.4588	1.4588	1.4588	0.000	2	0	40
3	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40
30	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	2	40	40

Statistical Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Graphical Method	
Prin Level	EC50
0.0%	0.9487

0.9487





DEPARTMENT OF THE AIR FORCE
AIR FORCE RESEARCH LABORATORY (AFRL)
TYNDALL AIR FORCE BASE, FLORIDA

JAN 24 2008

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
ATTN: DTIC-OQ (Laurence Ramserran)

FROM: AFRL/RXQ-TIC (Mr. Poulis)
139 Barnes Drive, Ste 2
Tyndall AFB FL 32403

SUBJECT: Changing Distribution Statements

1. Per request from Mr. Virgil Carr of our Air Force Research Lab (AFRL/RXQD), this letter authorizes the Defense Technical Information Center (DTIC) to change the distribution statement of the following three reports from "B" limited distribution, to public release, unlimited distribution "A":

a) AFRL-ML-TY-TR-2005-4580, Aquatic Toxicity Screening of Fire Fighting Agents, 2004 Report.

b) AFRL-ML-TY-TR-2004-4524, 2003 Report on Aquatic Toxicity Screening of Fire Fighting Agents.

c) AFRL-ML-TY-TR-2005-4581, Extinguishment and Burnback Testing of Fire Fighting Agents, 2004 Report.

2. I understand that this letter will be scanned to the back of each document and will become a permanent record.

ANDREW D. POULIS
STINFO Officer